Scholar Publishing Group
International Journal of Social Sciences and Economic Management
https://doi.org/10.38007/IJSSEM.2021.020106
ISSN 2789-715X Vol. 2, Issue 1: 62-81

The Complementarity of China-EU Industrial Manufactured Products Trade based on the Belt and Road Initiative

Saind Musse Abdullahi*

Saigon University, Vietnam

**corresponding author*

Keywords: One Belt One Road, Manufactured Goods, Trade Complementarity, Influencing Factors

Abstract: As the final node of the "One Belt One Road" initiative, Europe is also Chinese largest trading partner, and has always played an important role in the exchange of goods between the East and the West. The commodities traded between China and Europe are generally based on manufactured products. This article aims to study the complementarity of China-EU industrial trade based on the "Belt and Road" initiative. Survey and the proportion of Central European countries in all levels of manufactured goods trade. This article proposes to use an analytical method to explore the important factors affecting the trade complementarity of China and European industrial products, and use the intra-industry trade index, business complementarity index and business integration index to analyze the complementarity of industrial products between China and European countries. Then through the analysis of the development status of the industrial products trade of the two sides, the overall trend of the industrial products trade development of the two sides can be obtained. The results prove that China and European countries are highly complementary in low- and medium-tech industrial manufactured products, with a trade complementarity index of 1.798, which is relatively stable and both are greater than 1, and there is great potential for development. However, as a whole, the complementarity of manufactured products with medium and high technology content is relatively low. The average trade complementarity index is 0.792, and the index is less than 1, and the development potential is relatively low. As far as high-tech industrial products are concerned, they are highly complementary to some European countries, but not highly complementary to other European countries, but generally speaking, their development potential is very good and relatively optimistic. Therefore, studying the complementarity and competitiveness of China-Europe industrial products trade will help to understand the current situation of Chinese industrial products trade and discover the gaps between China and European industrial products. It is of practical significance to improve the competitiveness of Chinese industrial products trade and to strengthen China-Europe industrial products trade.

1. Introduction

In recent years, the level of economic globalization has continued to increase, and it is necessary for all countries to work together to maintain the sustainable development of the global economy. International trade can effectively promote economic globalization and sustainable development. All countries must fully consider the impact on other countries when implementing economic policies. The prospects for the current global economic recovery continue to improve, and global trade should also enter a new stage of development to boost economic growth. "One Belt, One Road" is a new type of economic globalization strategy proposed by country. It aims at promoting economic and trade cooperation and achieving mutual benefit and win-win; based on the principle of "common consultation, joint contribution and sharing", it will effectively promote the development of world economy and trade. China and Europe have always been each other's most important trading partners. The differences in the development stage and economic structure of the two countries have made the economic relations between the two parties have great potential for development. With the acceleration of economic globalization and the extension of global value chains, the economic and trade cooperation between China and Europe has developed rapidly. As the pillar industry of the national economy, manufactured products are playing an increasingly important role in bilateral trade between China and Europe. Studying the development status of China-Europe industrial products trade is helpful to understand the complementarity and competitiveness of industrial products trade in the international market.

After the "Belt and Road" initiative was launched, it has attracted widespread attention from scholars at home and abroad. As the world's largest exporter, China has gradually shown its competitiveness in manufactured products, and its technological content and added value have also been continuously increasing. Studying the trade complementarity between China and European industrial products and the influencing factors of the formation of trade complementarity play a pivotal role in tapping the potential of trade between China and European countries in the industrial field. At the same time, the trade cooperation between the two parties has played a good role in promoting country's deepening of diplomacy, and can improve country's opening-up trade pattern. Analyzing the trade structure, closeness of trade exchanges, comparative advantages of imports and exports, and abundance of resource endowments between China and Europe will provide a basis for further deepening trade cooperation between the two sides.

The "One Belt, One Road" initiative has brought historical opportunities for Chinese trade development. However, there are still some challenges in the process of internationalization of trade exports, such as limited supply of specific talents, weak industrial products, weak influence of international brands, imperfect systems, and regional imbalances. The development of trade must focus on the requirements of the "One Belt and One Road" and adhere to the development strategy of combining inheritance and development, combining government and people, and combining education with industry. At the same time, it is necessary to build a coordinated system between trade and the "Belt and Road", promote international recognition of trade and exports based on the standard system, and give full play to international discourse power and leading advantages. It is necessary to improve trade exchanges and improve export trade. Based on the 2006-2016 data provided by the United Nations Commodity Trade Database, Xiaoyu H U uses the trade competitive advantage index, trade intensity index and trade complementarity index to conduct empirical analysis on the development of agricultural trade. The results show that the scale of agricultural trade between China and the four South Asian countries has further expanded, but the growth rate has been stable and the trade share has declined, but the development potential of both parties has

not been fully tapped. On the whole, the country's agricultural products are still in a relatively weak position, but trade competitiveness and complementarity coexist. China and the four major countries in South Asia have great potential for the development of agricultural product trade and great room for cooperation. However, his research is not comprehensive enough to analyze the similarity between China and the other four countries in agricultural exports [1]. Ibrahim K H used a simple descriptive analysis and trade complementarity index to examine the Nigeria-India bilateral trade relationship from 2000 to 2014. Evidence of trade composition results shows that Nigeria's imports from India are more diversified than exports. All the major products that Nigeria imports from India account for a large share of its total imports, and for exports, it seems that only fossil fuels contribute a lot to Nigeria's exports to India. During the entire period, Nigeria's export supply and India's import demand were partially matched, and the trade complementarity index was between 31.98 and 45.21. Although there is a partial import and export match between Nigeria and India, the trade complementarity index has been rising steadily from 2000 to 2014, which means that the trade conditions between Nigeria and India have become more compatible. Therefore, the study also recommends that the Nigerian government, export promotion agencies, ministries, exporters and other stakeholders should focus on the issue of identification. But his research is not accurate enough in the calculation of trade complementarity index [2]. Maryam J empirically examines the trade flows between India and the BRIC countries. The Bilateral Explicit Comparative Advantage Index (BRCA) is used to assess the comparative advantage of India's exports to the BRICS during the period 2001-2015. In addition, the Trade Complementarity Index (TCI) between India and other BRICS countries was also reviewed. The study uses a trade gravity model to find the role of selected variables in promoting trade between India and the BRIC countries. The BRCA survey results concluded that India has comparative advantages mainly in agriculture and related products, followed by manufacturing and man-made products. BRCA analysis shows that between 2001 and 2015, India's export basket to the BRICS countries experienced minor structural changes. The higher TCI value indicates the range of trade potential between India and the BRIC countries. The results of the panel gravity model of exports, imports, and trade show that most variables have expected signs and are statistically significant. However, his research is not complete enough to explain the trade structure of both parties [3]. Fan Z estimated the efficiency of Chinese foreign direct investment in 69 countries along the "Belt and Road" and its influencing factors from 2003 to 2013. He defined the scope of the "Belt and Road" based on geographic boundaries, proved the application of the stochastic frontier gravity model in FDI analysis, and then constructed a frontier regression model to evaluate the efficiency of Chinese foreign direct investment and the determinants of countries along the "Belt and Road". He found that-regarding the estimation of core gravity parameters, Chinese foreign direct investment is highly consistent with the gravity model. From the perspective of policy parameters, Chinese foreign direct investment is severely restricted by some man-made barriers in the host country. According to the estimated FDI efficiency score, China has great potential for foreign direct investment in countries along the "Belt and Road". Overall, from 2003 to 2013, the efficiency of Chinese foreign direct investment showed a continuous upward trend in terms of FDI flow and FDI stock. But the random gravity model he designed is too complicated in algorithm [4]. Shiferaw A uses a large number of samples from developed economies, developing economies, and transition economies to study the industry-level responses of manufacturing employment in the context of globalization. It was found that developing countries need an abnormally high value-added growth rate (about 10%) to significantly increase manufacturing employment (about 4%). Even in the "comparative advantage" industries of developing countries, export-oriented employment gains are not large. However, the diversification

of the export basket has made a significant contribution to employment growth, especially in high-tech industries. Import competition will not undermine employment growth in low-tech industries in developing countries, but it will replace jobs in the same industries in the Organization for Economic Cooperation and Development (OECD) and transition economies. For developing countries, there are more unemployment caused by imports in the more capital-intensive middle-tech industries. Jobs in high-tech industries are less sensitive to imports and are positively correlated. However, he did not consider the trade comparative advantage index in his research and analysis of trade competitiveness, and his research was not rigorous enough [5]. Eor MK analyzed the agricultural production factors, productivity and trade structure of China, Japan and South Korea. Their agriculture is complementary due to different factor endowments, and mutually competitive due to similar production structures. Although the agriculture of these three countries all share the common characteristics of small-scale agriculture, the capital/labor ratio and labor/land ratio vary from country to country. Therefore, Japan and South Korea have advantages in producing labor-intensive and capital-intensive products, while China has advantages in labor-intensive and capital-intensive products. As the agricultural productivity of factors such as labor, land, and capital varies from country to country, it is possible to achieve mutually beneficial and win-win development through agricultural cooperation in Northeast Asia. The agricultural products of China, Japan, and South Korea can be divided into two types of products that compete with each other and complement each other. However, he did not consider the main factors of productivity in his research, and there are still deficiencies in the research [6]. The innovation of this article is that when studying the status quo of industrial trade between China and Europe, it not only analyzes the status quo of trade between China and Europe, but also compares and analyzes the status quo of trade between China and European countries. In the index analysis of the trade complementarity and competitiveness of industrial products between China and Europe, the relative trade advantage index of industrial products between China and European countries is used to analyze which products of each country have relative advantages. Compared with the explicit comparative advantage index used in previous studies, this index can evaluate the competitiveness of a country's products from two perspectives of import and export, making the research more accurate.

2. The Complementarity of China-Europe Industrial Manufactured Goods Trade based On the Belt and Road Initiative

2.1. "One Belt One Road" Cooperation Model

"One Belt One Road" is a strategy of China all-round opening to the outside world[7] and a cooperation strategy to promote economic regionalization. The network formed by its economic and trade relations is complex and objective[8]. This will help strengthen bilateral cooperation in goods trade and service trade, and promote the common prosperity and development of regional economies. Figure 1 shows the "Belt and Road" trade cooperation model.

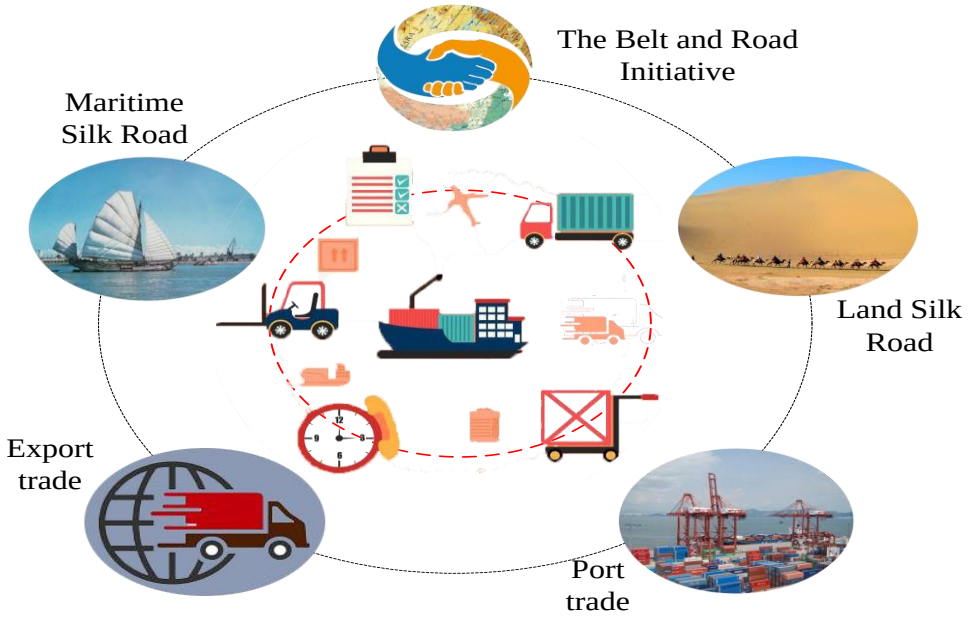

Figure 1."One belt, one road" trade cooperation mode

The "Belt and Road" goods trade cooperation network has the characteristics of a small world. Figure 2 is the "Belt and Road"economic and trade cooperation network.

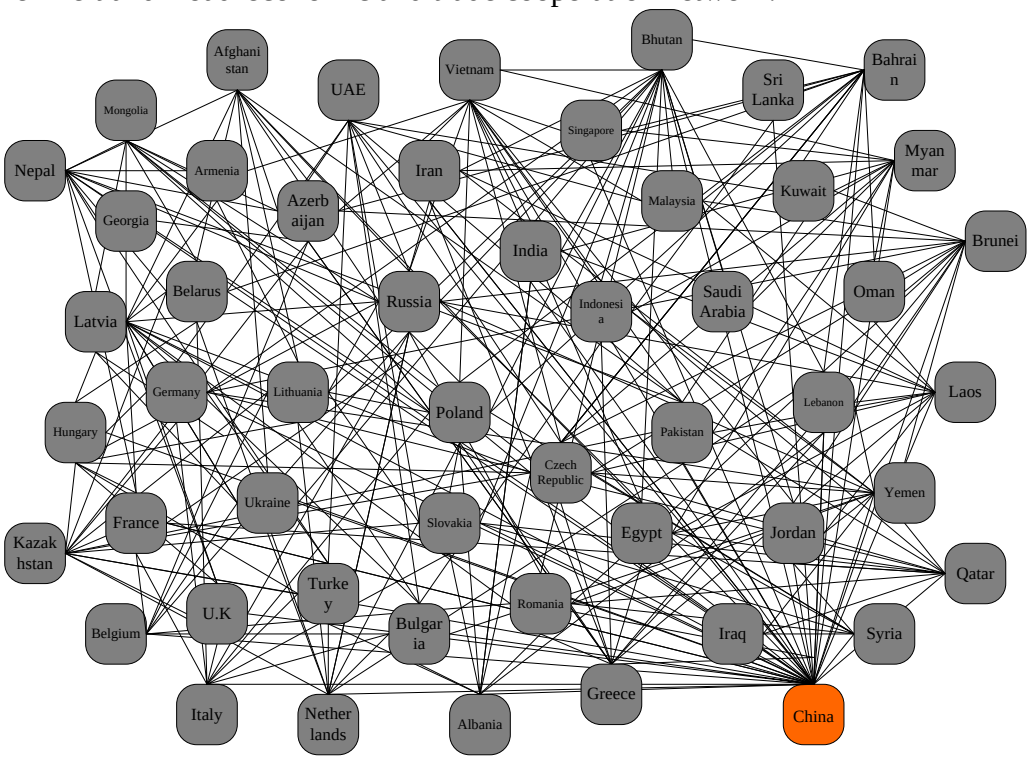

Figure 2. Network map of economic and trade cooperation among countries along the "Belt and Road"

It can be inferred that the network is a small world network. Small-world networks are close to

random networks and have greater clustering properties than random networks. It is credible to use random models and random processes to simulate the actual behavior of node countries.

2.2. Trade Complementarity

Trade complementarity can be divided into intra-industry complementarity and intra-industry complementarity according to international trade [9-10]. Inter-industry complementarity means that the two parties trade export products with their own comparative advantages and import products with their own disadvantages to achieve the goal of mutual benefit [11]. Intra-industry complementarity refers to the vertical complementarity of both parties in the same industry, and is an advanced form of international division of labor and production cooperation [12]. The possibility of trade between the two countries with complementary trade will increase significantly. The larger the trade space and the larger the transaction volume, the more benefits both parties will gain. Therefore, whether it is regional economic development or international trade development, all parties in trade should tap each other's trade potential and conduct specialized production through a reasonable division of labor to form complementary advantages and disadvantages [13-14].

2.3. Trade Complementarity Index

In order to analyze the trade complementarity of China-EU industrial products in detail, this paper analyzes the complementarity of China-EU industrial export trade and China-EU industrial import trade complementarity.

Comparing Chinese processed goods trade complementarity index with the import trade structure of different countries, if a country's import structure matches Chinese export structure, the two trade complementarity is relatively high and strong [15-16], the trade potential is huge, and there are great opportunities for cooperation. Conversely, if a country's import structure does not match Chinese export structure, it indicates that the trade complementarity between the two is low, and there is no trade potential. The prospects for cooperation are not high [17-18]. It calculates the trade complementarity index through an algorithm to get its trade complementarity index.

Let AA be the trade complementarity index, then:

$$AB = 1 - \frac{1}{2}\sum_{i}\left|s_{ir}^{n} - s_{jr}^{n}\right| \tag{1}$$

$$AC = \frac{\sum_{i} s_{ir}^{n} s_{jr}^{n}}{\sqrt{\sum_{i}\left(s_{ir}^{n}\right)^{2}\sum_{i}\left(s_{jr}^{n}\right)^{2}}} \tag{2}$$

$$AA = \frac{AB + AC}{2} \tag{3}$$

In the formula, s_{ir}^{n} represents the proportion of the country's total exports during the time period; s_{jr}^{n} represents the proportion of the total exports, if AC=BC=1. It means that the export structure of the country is completely consistent with the structure of the importing country, indicating that the higher the trade complementarity between the two countries, the greater the trade potential.

The most commonly used calculation methods of trade complementarity index in the existing literature are:

$$AA(Dry)=\sum_{i-1}^{n}\left(AB_{ir}\times AC_{jr}\times\frac{N_{i\gamma}}{N_{j\gamma}}\right) \tag{4}$$

AB_{ir} represents the comparative advantage of r goods in country i, and AC_{jr} represents the comparative advantage of r goods in country j and the proportion of r goods in the world's imports. Assume that the export volume of world trade equals the import volume:

$$AA(Dry)=\sum_{i-1}^{n}\left(\frac{V_{ir}}{n_{i\gamma}}\times\frac{N_{i\gamma}}{N_{j\gamma}}\times AB_{i\gamma}\right)\left(AB_{ir}\times AC_{jr}\times\frac{N_{i\gamma}}{N_{j\gamma}}\right) \tag{5}$$

If AA(Dry)=1, the import and export cargo structure of the two countries is exactly the same, and the result of the complementarity calculation should be relatively large.

$$AA=\sum_{i=1}^{n}\min\left(AB_{ir},N_{i\gamma}\right) \tag{6}$$

When the export structure of one country is exactly the same as the import structure of another country, the maximum value of AA is 1. When the import and export structures of the two countries do not match at all, the minimum value of AA is 0.

2.4. Trade Competitiveness Index

Through the comparative analysis of the industrial product export similarity index, they study the competitiveness of Chinese and European industrial product exports in the world market [19], and eliminate the impact of the difference in economic scale between the two. The formula is:

$$\overline{Q}_{n}^{t}=\sum_{i}\left[\frac{\left(L_{in}^{e}/L_{im}^{e}\right)+\left(L_{jn}^{e}/L_{jm}^{e}\right)}{2}\right] \tag{7}$$

$$\overline{Q}_{m}^{t}=1-\left|\frac{\left(L_{in}^{e}/L_{im}^{e}\right)-\left(L_{jn}^{e}/L_{jm}^{e}\right)}{\left(L_{in}^{e}/L_{im}^{e}\right)+\left(L_{jn}^{e}/L_{jm}^{e}\right)}\right| \tag{8}$$

$$\overline{Q}_{mn}^{t}=\left\{\sum_{i}\left[\frac{\left(L_{in}^{e}/L_{im}^{e}\right)+\left(L_{jn}^{e}/L_{jm}^{e}\right)}{2}\right]\times\left[1-\left|\frac{\left(L_{in}^{e}/L_{im}^{e}\right)-\left(L_{jn}^{e}/L_{jm}^{e}\right)}{\left(L_{in}^{e}/L_{im}^{e}\right)+\left(L_{jn}^{e}/L_{jm}^{e}\right)}\right|\right]\right\}\times100\% \tag{9}$$

Among them, $\overline{Q}_{mn}^{t}$ represents the revised export similarity index of country m and country n. In the case of $\overline{Q}_{mn}^{t}=100$, it shows that the structure of the export products of the two countries is completely the same in the market, and in the case of $\overline{Q}_{mn}^{t}=0$, it shows that the structure of the export products of the two countries is completely different. The fact that $\overline{Q}_{mn}^{t}$ has increased over time shows that the structure of exports of the two countries is gradually converging.

In order to measure the closeness of trade links between trading countries, the Trade Intensity Index analyzes the growth potential of processed products from China and European trading

countries [20], expressed by the following equation:

$$K_{im} = (G_{im} - W_{im})/(G_{im} + W_{im}) \tag{10}$$

$$K_{mn}^{t} = \frac{G_{mn}^{t} / G_{nv}^{t}}{W_{mv}^{t} / (W_{mm}^{t} - W_{nv}^{t})} \tag{11}$$

Among them, K_{mn}^{t} represents the trade intensity index of manufactured goods in country m and country n. In the case of $K_{mn}^{t} > 1$, it means that the export level of country m to country n is higher than the import level of products to country n at the same time, which means the degree of trade relations between the products of the two countries is high. Generally speaking, the higher the value of K_{mn}^{t}, the higher the trade complementarity between the two countries.

2.5. Stochastic Frontier Gravity Model and Trade Inefficiency Model

The stochastic frontier analysis method is used to analyze the technical performance of the production function [21]. It is a regression model using the term complex interpolation, a random error term in the traditional sense, used to reflect measurement deviation and statistical deviation [22-23]. The traditional gravity model believes that the transaction size is a function of the geographic distance and economic scale of the two parties, but it is difficult to correct the measurement deviation caused by unobservable factors [24-25]. The stochastic frontier weighting model can give the best size of the two-party transaction, that is, the transaction potential, taking other factors into consideration[26]. By using the ratio of actual trade scale to trade potential to find the efficiency level, analyze the factors that affect trade inefficiency, and propose policies to expand trade potential [27-28].

The general probability model of frontier gravity is:

$$W_{ab} = p(R_{ab}, \alpha)\exp(s_{ab})\exp(-\varepsilon_{ab}) \tag{12}$$

Take the logarithm of both sides to get:

$$\ln W_{ab} = \ln p(R_{ab}, \alpha) + s_{ab} - \varepsilon_{ab} \tag{13}$$

A is the parameter to be estimated, s_{ab} is the random disturbance term, and ε_{ab} is the trade inefficiency term. If ε_{ab} does not change, then:

$$\varepsilon_{ab} = \{\exp[-\varepsilon(y - Y)]\}\varepsilon_i \tag{14}$$

Among them, y represents the year, and Y represents the number of periods. The trade potential and trade efficiency can be calculated as:

$$\overline{W}_{ab} = p(R_{ab}, \alpha)\exp(s_{ab}) \tag{15}$$

$$WP_{ab} = W_{ab} / \overline{W}_{ab} = \exp(-\varepsilon_{ab}) \tag{16}$$

WP_{ab} is the ratio of the actual trade volume to the trade potential. When $WP_{ab} = 1$, it means that the optimal trade level has been reached. Among them, the trade inefficiency term ε_{ab} is defined as:

$$\varepsilon_{ab} = \alpha'' N_{ab} + \varphi_{ab} \tag{17}$$

$$\ln W_{ab} = \ln p(R_{ab}, \alpha) + s_{ab} - (\alpha'' N_{ab} + \varphi_{ab}) \tag{18}$$

Key variables such as geographic distance, economic scale, and market demand include factors that will not change in the short term. Inefficiency includes factors such as economic system, regional organization, and infrastructure. Measuring the level of commercial resistance in trade and building a model on this basis.

$$\ln W_{ab}\alpha_0 + \alpha_1 \ln RP_{ab} + \alpha_2 \ln RP_{ab} + \alpha_3 \ln RP_{ab} + s_{ab} - \varepsilon_{ab} \tag{19}$$

$$\varepsilon_{ab} = \alpha_0 \varphi_{ab} + \alpha_1 \varphi_{ab} + \alpha_2 \varphi_{ab} + \alpha_3 \varphi_{ab} \tag{20}$$

The regression results of the stochastic frontier model and the trade inefficiency model are shown in Table 1.

Table 1. Regression results of factors affecting trade complementarity

Explanatory variables	coefficient	Standard error	Statistics	coefficient	Standard error	Statistics
Inpd	0.026	0.051	0.51	0.148	0.075	1.98
Inindustry	0.189	0.098	1.93	-0.833	0.115	-0.72
lngdp	-0.065	0.117	-0.55	6.635	1.881	3.53
sqingdp	/	/	/	-3.918	0.106	-3.69
lnpgdp	-0.189*.b	0.071	-2.65	-0.224	0.124	-1.8
Inrd	0.452	0.161	2.81	-0.404	0.186	-2.17

Table 1 shows the regression coefficients of trade influencing factors. The product difference index is significant at the level of 5%, which has a positive impact on trade complementarity. That is, the greater the difference in the industrial products China imports from China and Europe, the stronger the complementarity between the two parties.

3. Influencing Factors of Trade Complementarity

3.1. Factors Influencing the Complementarity of Trade in Manufactured Goods between China and Europe

(1) Product differentiation

According to the theory of intra-industry trade, heterogeneous products can meet the different consumer needs of various consumers, which in turn enables different producers to occupy different dominant positions in the international market. Trade exchanges between the two countries with product differences can effectively improve the living standards of the two peoples. The greater the difference between the products of the two countries, the more they can meet the consumer needs of various consumers, and thus the greater the possibility of trade exchange between the two countries and the stronger trade complementarity. Conversely, the smaller the product difference, the weaker the ability to satisfy consumers, the less likely the two countries to trade, and the weaker the trade complementarity [29-30].

(2) Differences in product structure

According to the theory of intra-industry trade, heterogeneous products can meet the different consumer needs of various consumers, which in turn enables different producers to occupy different dominant positions in the international market. Trade exchanges between the two countries with product differences can effectively improve the living standards of the two peoples. The greater the difference between the products of the two countries, the more they can meet the consumer needs of various consumers, and thus the greater the possibility of trade exchange between the two countries and the stronger trade complementarity. Conversely, the smaller the product difference, the weaker the ability to satisfy consumers, the smaller the possibility of trade between the two countries, and the weaker the trade complementarity.

(3) Difference in market size

The basis of import is demand. When the country's total supply and output structure are constant, the larger the market size, the greater the demand for imports. To a certain extent, the market scale can reflect the scale of a country's economic development. As the total economic volume of a country continues to rise, the market scale will gradually expand. If the difference in market size between the two countries is reduced, the demand in the consumer markets of both sides will increase significantly and the level of demand will continue to increase, which will provide a good opportunity for trade exchanges between the two parties and significantly increase trade complementarity; on the contrary, the greater the difference in market size, the weaker the complementarity.

(4) Other factors

National policies, culture, religion, politics and many other aspects are also important factors influencing the complementarity of trade between China and Europe. The "Belt and Road" initiative is an important decision made by China to plan an all-round reform and opening up pattern. China has actively promulgated supporting policies in fiscal and taxation, finance, investment and trade cooperation, customs, and transportation to escort this strategy. As countries along the route, China and Europe are inclined by national policies. The two sides will form a new trade cooperation model, expand cooperation fields, promote trade transformation and upgrading, optimize trade structure, and greatly promote the development of bilateral trade. However, the complex political situation between China and European countries, the difficulty of market opening, the complex ethnic and religious contradictions, and the complex and diverse cultures have also played a certain role in hindering the development of bilateral trade. Trade cooperation between China and European countries is playing an increasingly important role in the development of each other's national economy and foreign trade. Generally, the scale of trade is used to reflect the closeness of both sides of the trade, and the closeness of trade increases with the increase of the scale. The trade structure can highlight the differences between the two countries in terms of international division of labor and industrial structure. This chapter will analyze the status quo of trade development between China and European countries and the status quo of industrial trade development of the two sides, which will lay the foundation for the analysis of trade complementarity later.

4. The Complementarity of China-Europe Industrial Manufactured Products Trade based on the Belt and Road Initiative

4.1. Sino-European Trade Volume

This article divides European countries into Southern Europe, Western Europe, Central and Eastern Europe, and the Commonwealth of Independent States. Southern Europe includes Serbia, Croatia, Slovenia, Italy and other countries. Western Europe includes countries such as Germany,

France, the United Kingdom, the Netherlands and Belgium, Central and Eastern Europe includes countries such as Poland and Hungary, and the Commonwealth of Independent States includes countries such as Russia, Belarus, Ukraine and Kazakhstan. Among them, Kazakhstan and Russia are included in the Commonwealth of Independent States because they straddle the two continents of Asia and Europe and are also an important part of the "belt and road". The trade cooperation between China and Central European countries is playing an increasingly important role in the development of each other's national economy and foreign trade. Generally, the scale of trade is used to reflect the closeness of both sides of the trade, and the closeness of trade increases with the increase of the scale. The trade structure can highlight the differences between the two countries in terms of international division of labor and industrial structure. It will analyze the status quo of trade development between China and Europe and the status quo of industrial trade development of both sides, which can lay the foundation for the analysis of trade complementarity later.

Since 2007, the total trade volume between China and Europe has declined in a few years, but on the whole it has shown an upward trend. As shown in Figure 3, the balance of Chinese export trade more than doubled in 2016, but after a significant adjustment in 2017, total exports to the EU are increasing. 2017 is 1.5 times that of 10 years ago. As shown in Figure 4, the value of imports is also on the rise, with an average annual growth rate of about 9.77%. In general, China-EU trade has shown good growth potential and maintained steady growth. In the future, China is expected to maintain a relatively high position, and the surplus will continue to grow.

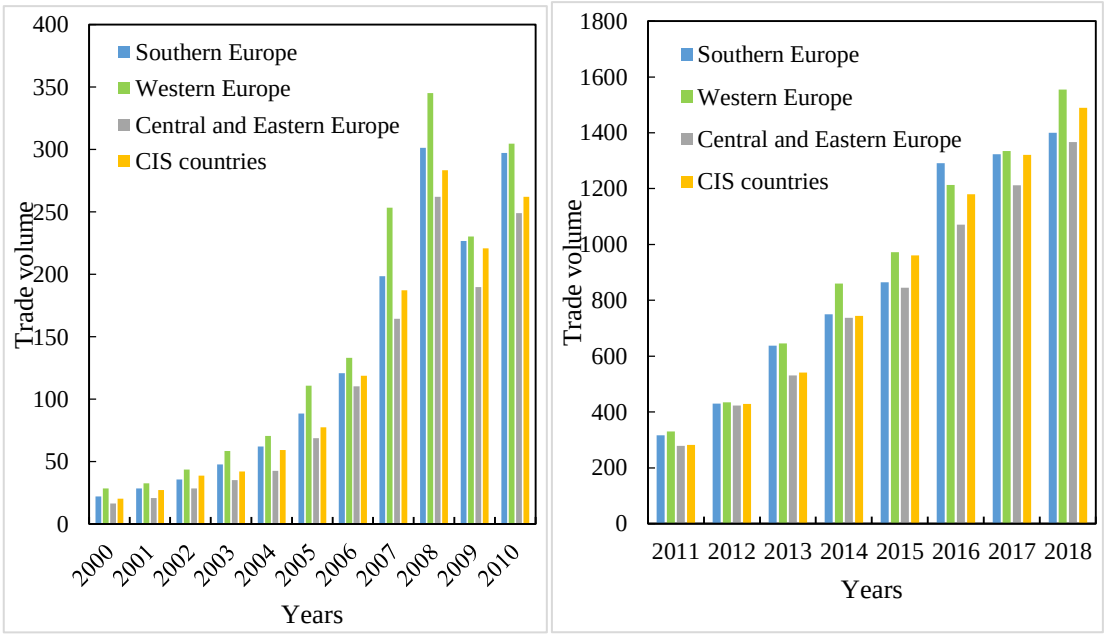

Figure 3. 2000-2018 China-EU export trade volume

From the perspective of trade balance, the bilateral trade between China and China and Europe is not balanced, but it has been on an upward trend since 2009, due to the global financial turmoil, which gradually picked up in 2010. From the perspective of the proportion of Chinese total trade, China and Europe account for a larger share and show an upward trend, as shown in Figure 5.

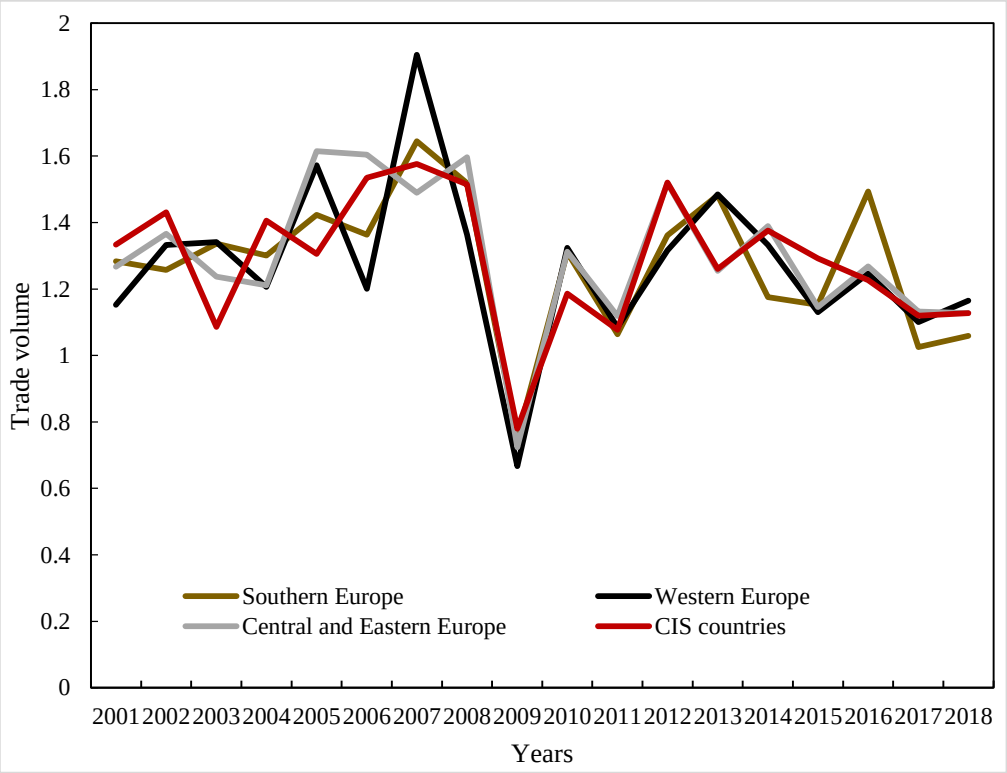

Figure 4. The growth rate of China-EU export trade volume from 2000 to 2018

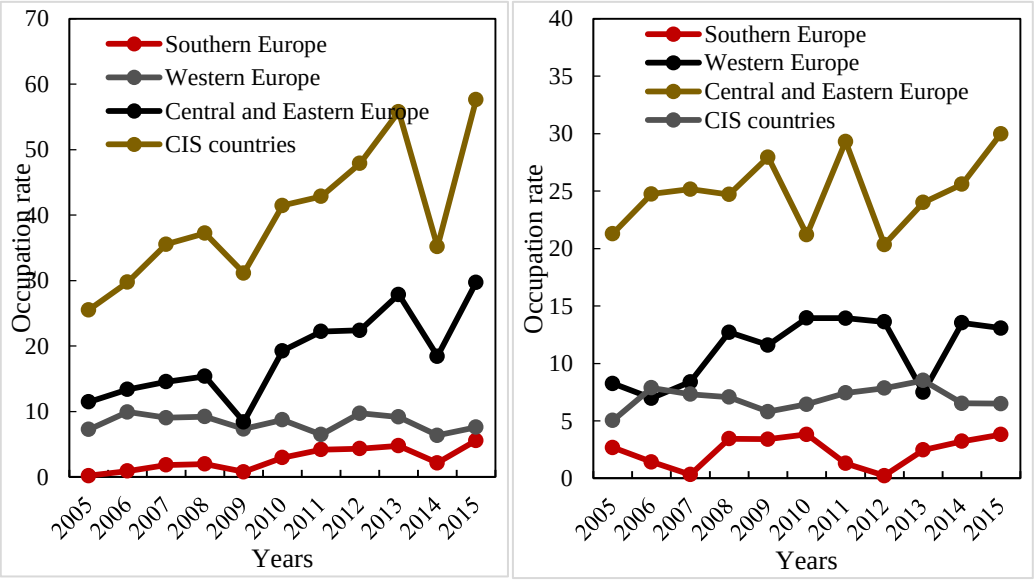

Figure 5. The share of China and Europe in the trade volume between China and Europe

The China-EU trade integration index is shown in Figure 6. From an overall point of view, the overall trade integration between China and European countries is between 1.25-1.68, and the overall trend is on the rise. The trade relations are not volatile and relatively stable.

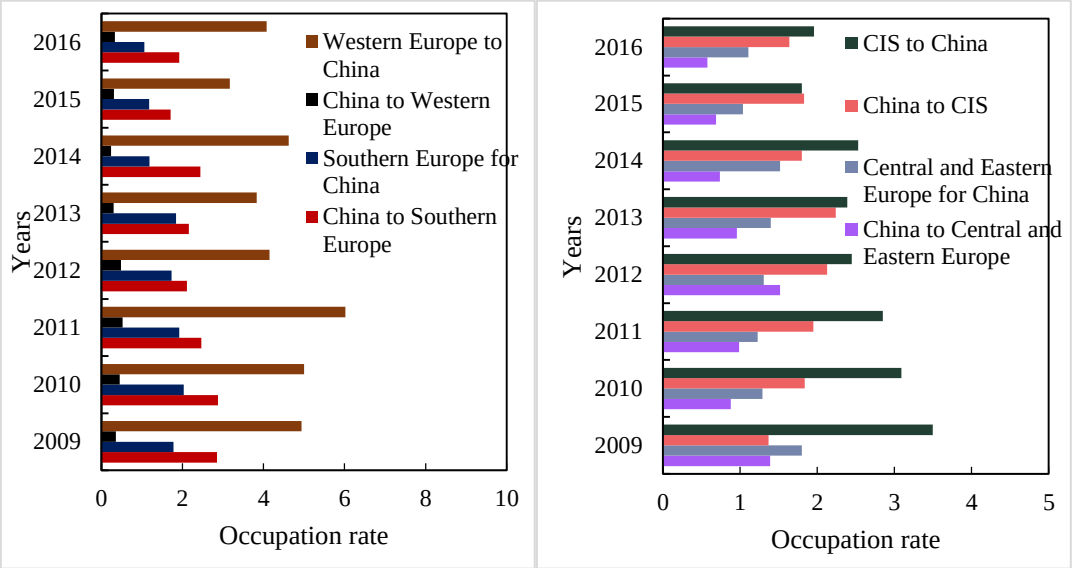

Figure 6. China-EU trade integration index

4.2. The Competitiveness of China-Eu Industrial Manufactured Goods Trade

From the perspective of the structure of China-EU trade export of manufactured goods, the structure of China-EU trade export products is very similar. It can be seen from Table 2 that China-EU export products are relatively similar, but their weights are quite different.

Table 2. Export structure of China-EU industrial products trade

Rank	China	Export proportion	Europe	Export proportion
1	Motor/Electrical Equipment	15.52	Jewelry and precious gold exhibition and products	18.74
2	Non-knitted/crocheted garments	11.21	cotton	11.1
3	Nuclear reactor/boiler/machinery	8.39	Non-knitted/crocheted garments	10.68
4	Knitted/crocheted clothing	5.87	Nuclear reactor/boiler/machinery	4.11
5	Footwear, protective gear and the like	5.47	Knitted/crocheted clothing	4.06
6	Toy	4.6	Organic chemicals	3.9
7	Leather	3.64	Vehicles and their parts and accessories, except railway vehicles	3.54
8	Plastics and products	2.6	Steel	3.4
9	cotton	2.43	Motor/Electrical Equipment	3.37
10	Organic chemicals	2.42	Leather	3.09
11	Steel products	2.41	Other textile products	2.93
12	Steel	2.37	medical products	2.64
13	furniture	2.35	Carpets, special woven fabrics	2.56
14	Optical / film / metrological inspection	2.3	Other unclassified products	2.31
15	Other textile products	1.89	Footwear, leggings and similar	2.25

Figure 7 shows the similarity index of China-EU export trade. The closer the similarity is to 0, the lower the export similarity and the weaker the competitiveness. It can be seen from Figure 7 that the export similarity between the two sides is low and there is no competition. The trade between China and Europe's industrial products can play a better complementary role.

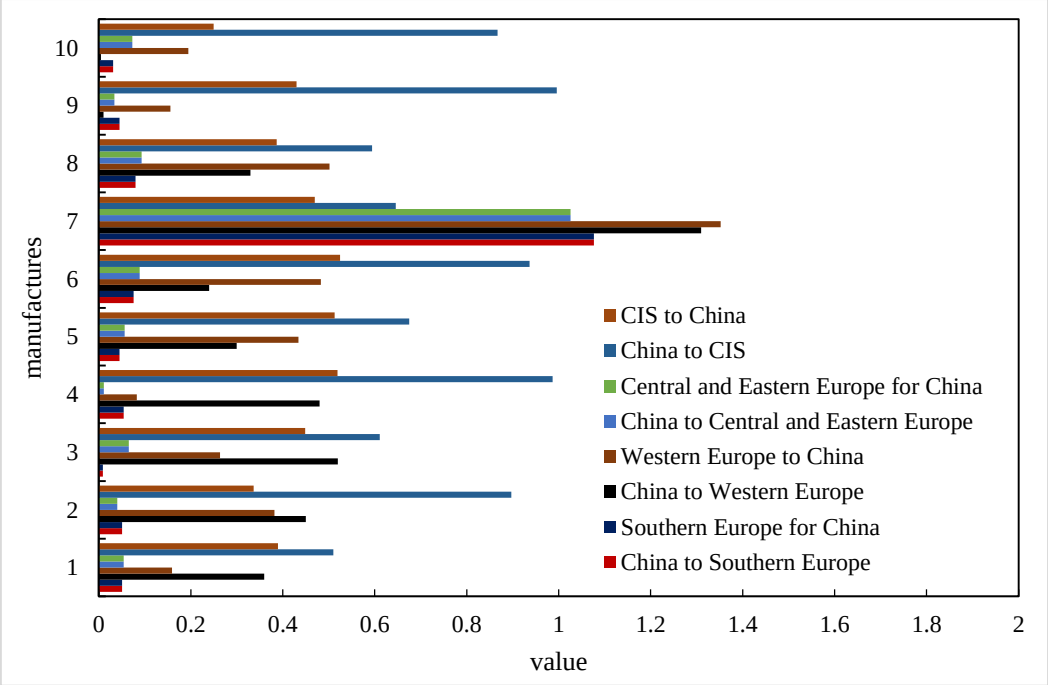

Figure 7. Similarity of China-EU industrial manufactured products trade

The competitiveness index of China-Europe industrial products trade is shown in Figure 8. It can be seen from the figure that the trade structure of China-EU industrial products is highly competitive. Through the analysis of relative trade advantage, it is found that the overall comparative advantage of Chinese industrial manufactured products is relatively strong and highly complementary.

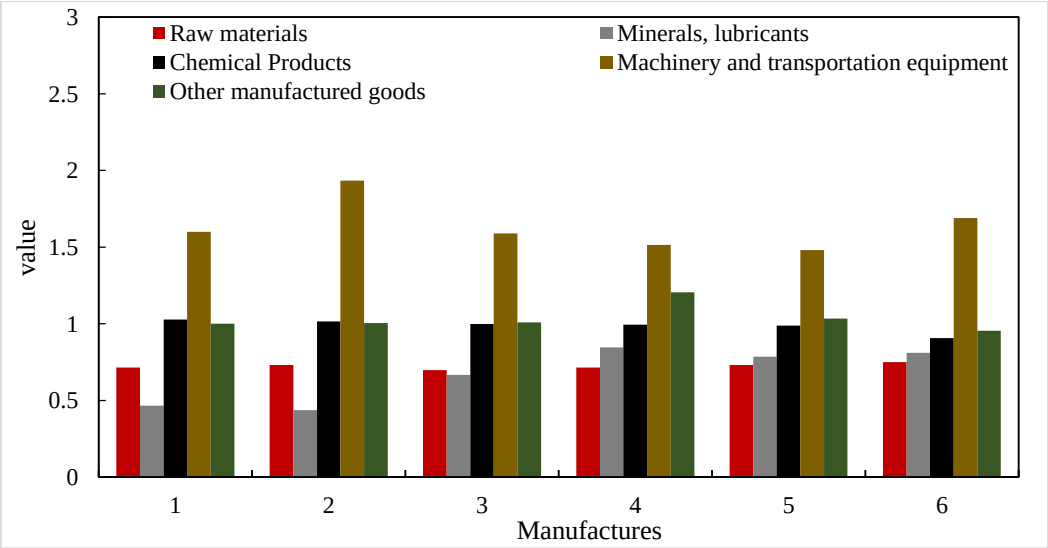

Figure 8. China-EU industrial manufactured products trade export competitiveness index

Trade intensity is the most important indicator to measure the dependence of the two countries on trade. Trade volume can be divided into export volume and import volume. Figure 9 shows the trade intensity index of manufactured goods between China and European countries.

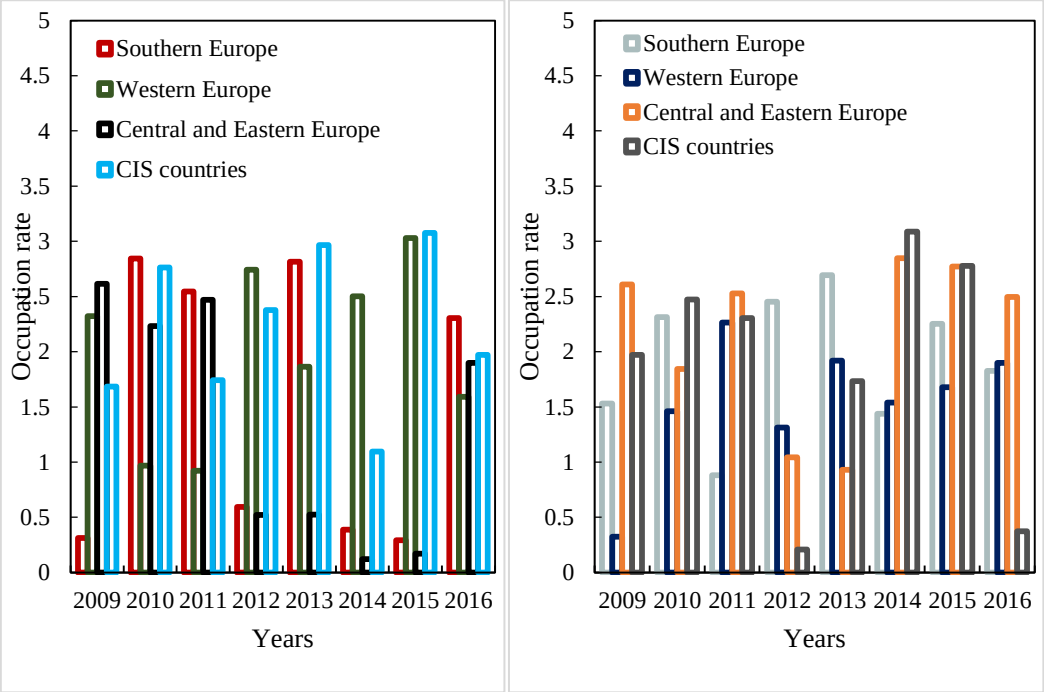

Figure 9. Trade intensity index of industrial products between China and European countries

A trade intensity greater than 1 means that the two countries have relatively close bilateral trade relations and are important trading partners. If the trade volume is less than 1, the two countries are still relatively weak. It can be seen from the figure that China and European countries have relatively high trade intensity and have close trade relations.

4.3. Complementarity of China-EU Industrial Manufactured Products Trade

According to the previous analysis of the competitiveness of the export market and the analysis of relative trade advantages, it is found that China and China and Europe have relatively high similarity in the export of industrial products, and they are competitive, and the types of industrial products with comparative advantages between China and Europe are not the same. Figure 10 shows the intra-industry trade index in foreign trade between China and European countries.

Figure 10 shows that Western Europe and the CIS countries are significantly higher than other regions, which means that these regions are also more dependent on the world economy than other regions. Therefore, the industrial products of China and China and Europe should show trade complementarity, but which industrial products exhibit trade complementarity and the degree of complementarity still need to be analyzed in detail through the calculation of the trade complementarity index. This indicator can be used to measure the degree of overlap between one country's exports and another country's imports.

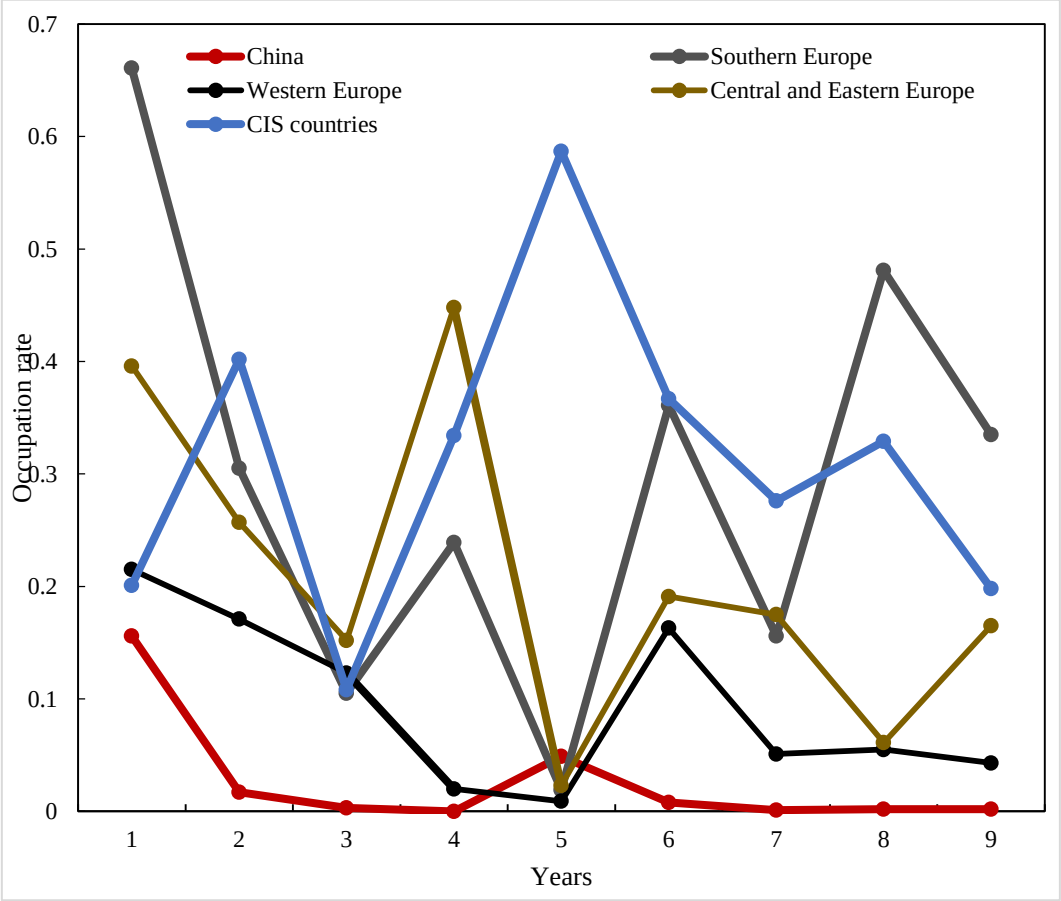

Figure 10. Intra-industry trade index in foreign trade of China and European countries

Table 3. China-EU intermediate and advanced industrial manufactured products trade complementarity index

Area	Years	High-tech industrial products	Medium high-tech industrial products
		Numerical value	Numerical value
Southern Europe	2009-2013	1.1593	0.8947
	2014-2018	1.2314	0.9235
Western Europe	2009-2013	2.2687	0.1817
	2014-2018	1.2536	0.9624
Central and Eastern Europe	2009-2013	2.1354	0.8432
	2014-2018	2.0847	0.7384
CIS countries	2009-2013	1.1876	0.9703
	2014-2018	2.1214	0.8214

Table 4. China-Europe low-grade and medium-low-grade manufactured goods trade complementarity index

Area	Years	Medium and low-grade industrial products	Low-grade industrial products
		Numerical value	Numerical value
Southern Europe	2009-2013	1.1593	1.8947
	2014-2018	2.2314	1.9235
Western Europe	2009-2013	1.2687	2.1817
	2014-2018	2.2536	1.9624
Central and Eastern Europe	2009-2013	2.1354	1.8432
	2014-2018	1.0847	1.7384
CIS countries	2009-2013	1.1876	1.9703
	2014-2018	2.1214	1.8214

This article divides industrial products into four categories, including high-tech industrial products, medium- and high-tech industrial products, medium- and low-tech industrial products, and low-tech industrial products. Table 3 shows the level of complementarity between high-tech and medium-high-tech industrial manufactured products. Table 4 shows the trade complementarity index of low-grade and medium-low-grade manufactured products between China and Europe.

It can be seen from the table that the trade complementarity index of high-tech industrial products and low- and medium-grade industrial products is generally high. Among them, the average trade complementarity of low- and medium-grade industrial products is 1.798, with an index greater than 1. The level of bilateral trade complementarity with European countries is relatively good, and it has great potential. The trade complementarity index of medium and high-tech industrial products is relatively low, with an average value of 0.792 and an index of less than 1, indicating little development potential.

Table 5. Calculation results of the trade potential of manufactured goods between China and European countries

Country	T (actual value)	T' (predicted value)	Trade potential	Potential type
Southern Europe	105388947	505471905.9	0.2085	Potential remodeling
Western Europe	149381642	315961840.3	0.4728	Huge Potential
Central and Eastern Europe	635061533	1226201047	0.5179	Potential remodeling
CIS countries	1260775437	1839472582	0.6854	Huge Potential

Table 5 is the calculation result of the trade potential of manufactured goods between China and Europe. It can be seen that the trade potential of Western Europe and the CIS countries is huge, and the two sides have relatively large trade potential. The level of economic development in these areas is relatively high, and the market capacity and scale are relatively large. By strengthening cooperation with these regions, the space for trade in manufactured products between the two parties can be further improved.

5. Conclusion

With the rapid development of Chinese economy, the difference in per capita income between China and Europe will shrink, which will help reduce the negative impact on China-EU intra-industry trade to a certain extent. With the advancement of Chinese industrial technology, the intra-industry trade between China and Europe tends to increase. Therefore, with the development of trade between the two countries, the prospects for intra-industry trade between the two countries are broad. This article is based on the "Belt and Road" survey on the complementarity of Sino-European industrial trade. Based on the "Belt and Road" initiative, the trade complementarity index is used to reflect and analyze the overall complementarity of the bilateral trade of industrial products between European countries and China, and calculate its trade potential. At the same time, industrial products are divided into four categories: high-tech products, medium-tech products, medium- and low-tech industrial products, and low-tech industrial products. It also analyzes the trade complementarity indexes of the four types of manufactured products. The analysis results show that industrial products with high trade complementarity between China and some of the more developed European countries are high-tech industrial products. Countries that are not so economically developed are mainly reflected in low-tech and medium- and low-tech industries. The analysis of the competitiveness of China-Europe industrial products trade also found that China and Europe's industrial products exports have a high degree of similarity, and the two sides are competitive in their industrial products.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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